

DEVELOPMENT OF PROTEIN RICH PRODUCTS USING SPIRULINA

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ABSTRACT

The present study was undertaken to assess the nutritional composition of spirulina powder, development of spirulina based products their nutritional composition and shelf life. Spirulina is a natural algae powder that is high in protein and a good source of antioxidants, B- vitamins and other useful nutrients. Food products were prepared by using spirulina powder along with other ingredients to prepare products having adequate taste. A control samples was also prepared. The best chosen product was assessing for their nutritional content. The analysis indicated that the fortified biscuits were significantly high in various nutrients. It contains higher levels of percent moisture, percent proteins, percent fat, percent crude fibre, percent ash, percent calcium, percent phosphorus and percent iron in comparison to the control samples. The biscuits were consumed by anemic patients for a span of 45 days, which yielded significant results. The developed products could be therapeutic for patients suffering from malnutrition and other degenerative diseases.

Key words:- Functional food, Spirulina, Anemia, Nutritional composition

I. INTRODUCTION

Functional food is a food where a new ingredient has been added to a food and the new product has an additional function. **Spirulina** now named *Arthrospira* is a microscopic and filamentous cyanobacterium that has a long history of use as a safe food lacking toxicity. Spirulina is the common name for human and animal food supplements produced primarily from two species of cyanobacteria *Arthrospira platensis* and *Arthrospira maxima*. Spirulina has many therapeutic properties such as hypocholesterolemic, immunological antiviral and antiglutagenic effect. **Anemia** remains a serious public health challenge worldwide. According to World Health Organization (WHO), an estimated 150 million individuals suffer from some type of anemia. It is an excellent source of protein. Today food is lower in essential nutrients than foods produced 50 years ago. Halving our world's number of victims of hunger and malnutrition (In absolute terms from 400 million to 800 million) the focus on protein calorie malnutrition in the third world countries was drawn by the FAO in sixties, which led to identification of newer protein source, particularly algae spirulina is used for boosting the immune system, lowering cholesterol, heart health, diabetes treatment, wound healing, improving digestive health and as an antidote to depression and anxiety. It is cultivated all around the world and is used as a human dietary supplement as well as whole food which is available in tablet, flake and powder form. Spirulina is marketed and consumed in Germany, Brazil, Philippines, India, Africa and other countries where public administration . Sanitary organization and associations have approved human Consumption.

II. NUTRITIVE VALUE OF SPIRULINA

Spirulina is a Super food, full of nutritional wonders, truly an amazing food. It regulates blood Sugar, blood pressure and Cholesterol. A food that can alleviate pain from inflammation and deliver antioxidant activity to ward off life threatening diseases like Cancer, Alzheimer's heart diseases and Stroke, a food that improves immune system, alleviate allergies and has been proven to fight many different viruses, a food that helps eyes and brain, helps in reducing weight, increases friendly flora in the intestine and improves digestion. Scientific research shows that Spirulina may help in all these areas and more. It contains every essential amino acids, more beta carotene than any other whole food, it is the best Whole food Source of gamma linolenic acid, B vitamins, minerals, trace elements, Chlorophyll and enzymes.

OBJECTIVES: -

- To develop value added products with incorporation of Spirulina.
- To assess the acceptable level of incorporation in products organoleptically
- To analyze and compare the nutritional consumption of the most acceptable develop product.
- The fortified food product has the significant increment in hemoglobin level in experimental group.

METHODOLOGY: -

1) **Procurement of spirulina:** - Spirulina powder was purchased from ‘‘S V AGRO Foods Company’’ New Delhi.

2) **Product development:** -The researcher decided to invent new recipes for utilizing spirulina in food products. Idea generation and screening of ideas were the initial steps of product development using food fortification. After trials of many recipes product enrichment and prototype development was taken up for the recipes with higher acceptability.

RECIPES	CHARACTERISTICS	PRIMARY INGREDIENTS	FORTIFYING INGREDIENTS
Biscuits	Control	Refined flour, ghee, flavoring agent	Spirulina 5 gm
	Fortified	Refined flour, ghee, flavoring agent, spirulina powder	
Pasta	Control	Refined flour, oil, flavoring agent	Spirulina 5 gm
	Fortified	Refined flour, oil, flavoring agent spirulina powder,	
Noodles	Control	Refined flour, oil, flavoring agent	Spirulina 5 gm
	Fortified	Refined flour, oil, flavoring agent spirulina powder,	
Ginger cookies	Control	Wheat flour, ghee, flavoring agent, ginger powder,	Spirulina 5 gm
	Fortified	Wheat flour, ghee, flavoring agent, ginger powder, spirulina powder,	
Peanut cookies	Control	Wheat flour, ghee, flavoring agent, crushed peanut	Spirulina 5 gm
	Fortified	Wheat flour, ghee, flavoring agent, crushed peanut, spirulina powder,	
Peanut butter	Control	Butter, peanut oil,	Spirulina 5 gm
	Fortified	Butter, peanut oil, spirulina powder	
Urad papad	Control	Urad flour, spices, oil,	Spirulina 5 gm
	Fortified	Urad flour, spices, oil, spirulina powder,	
Potato papad	Control	Potato, spices, oil	Spirulina 5 gm
	Fortified	Potato, spices, oil, spirulina powder,	

III. NUTRITIONAL AND SENSORY EVALUATION

On the basis of organoleptic evaluation of the eight products. Spirulina biscuits were found to be the best prepared, the spirulina biscuits were estimated for moisture, proteins, fat, crude fiber, ash, calcium, alcoholic acidity, ph, peroxide value, phosphorus and iron, in comparison with the control sample of biscuits.

Sensory evaluation included selection of semi trained panel using Control and iron fortified variants were subjected to 9 point hedonic test by a panel of 10 judges.

Table 2: - Nutritional analysis of control and fortified best selected products.

Nutrients	Control Biscuits	Fortified Biscuits
Moisture %	2.77	2.55
Protein %	4.49	20.43
Fat %	17.59	16.25
Fibre %	0.68	1.18
Ash %	3.08	4.07
Calcium mg/100 gm	214.15	288.98
Phosphorus mg/ 100 gm	54.34	115.92
Iron mg/100 gm	1.87	3.94
Alcoholic acidity %	0.24	0.30
ph	7.035	6.035
Peroxide value meq/kg	0.987	0.755

Result and Discussion: -

Nutritional Evaluation: - The nutrient content of 100 gm spirulina was analyzed and the results were given below

Table 1: - Nutrient content of spirulina powder (dried)

Nutritional value per 100 gm

Nutrient	Amount
Energy	1,213 kj (290 kcal)
Carbohydrates	23.9 gm
Dietary fiber	3.6 gm
Protein	57.47 gm
Fat	7.72 gm
Vitamin A equiv	29 µgm (4%)
Thiamine (B ₁)	2.38 mg (207%)
Riboflavin (B ₂)	3.67 mg (306%)
Niacin (B ₃)	12.82 mg (85%)
Vitamin (B ₆)	0.364 mg (28%)
Vitamin E	5 mg (33%)
Vitamin k	25.5 µgm (24%)
Calcium	120 mg (12%)
Iron	28.5 mg (219%)
Phosphorus	118 mg (17%)
Potassium	1363mg (29%)
Sodium	1048mg (70%)
Zinc	2 mg (21%)
Water	4.68 gm

Table 2: - Hedonic test score of control recipes and their fortifying variants

Recipes	Biscuits		Pasta		Noodles		Ginger cookies	
Type	Mean ± SD	CV	Mean ± SD	CV	Mean ± SD	CV	Mean ± SD	CV
Control	8.4 ± 0.62	7.37	7.7 ± 0.43	4.99	7.4 ± 0.50	6.03	7.8 ± 0.69	8.84
Fortified	8.9 ± 0.24	2.71	7.5 ± 0.62	7.32	7.8 ± 0.52	6.76	8.0 ± 0.35	4.42
Recipes	Peanut cookies		Peanut butter		Uradpapad		Potato papad	
Type	Mean ± SD	CV	Mean ± SD	CV	Mean ± SD	CV	Mean ± SD	CV
Control	7.1 ± 0.52	7.37	7.5 ± 0.62	7.32	7.4 ± 0.50	6.03	7.8 ± 0.52	6.76
Fortified	7.8 ± 0.52	6.76	8.0 ± 0.35	4.42	7.8 ± 0.52	6.76	8.0 ± 0.35	4.42

In Hedonic test the fortified biscuits had a mean score of 8.9. The likeability of this product is very high. The other products were also significant and liked very much by the panel members. The best chosen product got the maximum mean score in the hedonic rating test. So it was nutritionally analyzed by different nutrients.

Mean gain level among subjects during intervention

The present investigation revealed that the mean hemoglobin levels after 45 days of intervention in experimental group hiked to 9.42 gm/dl of mean hemoglobin, while the mean hemoglobin status of control group rendered as 7.94 gm/dl. In terms of statistical analysis experimental group showed highly significant increase ($p < 0.05$) in hemoglobin levels while the control group possessed almost initial level of hemoglobin with non significant variation.

Table 2: - Mean gain levels among subjects during intervention

Group	Mean hemoglobin gm/dl levels of the subjects					
	15 Days		30 Days		45 Days	
	Mean	S.D	Mean	S.D	Mean	S.D
Experimental group	0.54	0.17	1.09	0.17	1.63	0.22
Control group	0.04	0.07	0.12	0.09	0.18	0.14
S.E ±	0.12		0.13		0.18	
C.D P=0.05	0.34		0.28		0.38	

C D = Critical Difference

S.D = Standard Deviation

Storage Studies: - The storage studies for all the developed and fortified products were carried out for a period of 3 month. No contamination was found for the period of three months and the product is found to be safe till the observed period.

IV. CONCLUSION: -

Eight fortified products using 5% spirulina powder were acceptable. The products had a shelf life of 3 months. The best found product, spirulina biscuits was consumed by anemic patients, for a period of 45 days. Before and after blood test indicated significant changes in the hemoglobin status of the patients. The patients were randomly chosen from one clinic at Allahabad. Who were suffering from anemia. People of both sexes and also children were given 4 biscuits to be consumed at evening tea- time along with all other food they ate. The results were significant. Each patient showed improvement in hemoglobin levels, thereby enhancing his energy levels. The products could be beneficial to people suffering from malnutrition, lactating mother and anemic children. These valuable products possess great extrusion potential with higher acceptability on organoleptic parameters thus better quality of spirulina fortified products brings considerable advantages among the community. These developed products will not only improve the nutritional status of the community but also solve a number of nutritional problems prevailing in the community.

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